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RETRANSMISSION UNIT

SIERRA 942A

OPERATION MANUAL

PRELIMINARY

ALL MATERIAL SUBJECT TO CHANGE WITHOUT NOTICE

PHILCO Ford

PHILCO-FORD CORPORATION
Sierra Electronic Operation
Menlo Park, Calif. • 94025

testing 942A , with help of 940R.

1) 942A SETTINGS

A) Recieve Level

Sierra 942A

RETRANSMISSION UNIT

OPERATION MANUAL

SOM-942A

ISSUE 1

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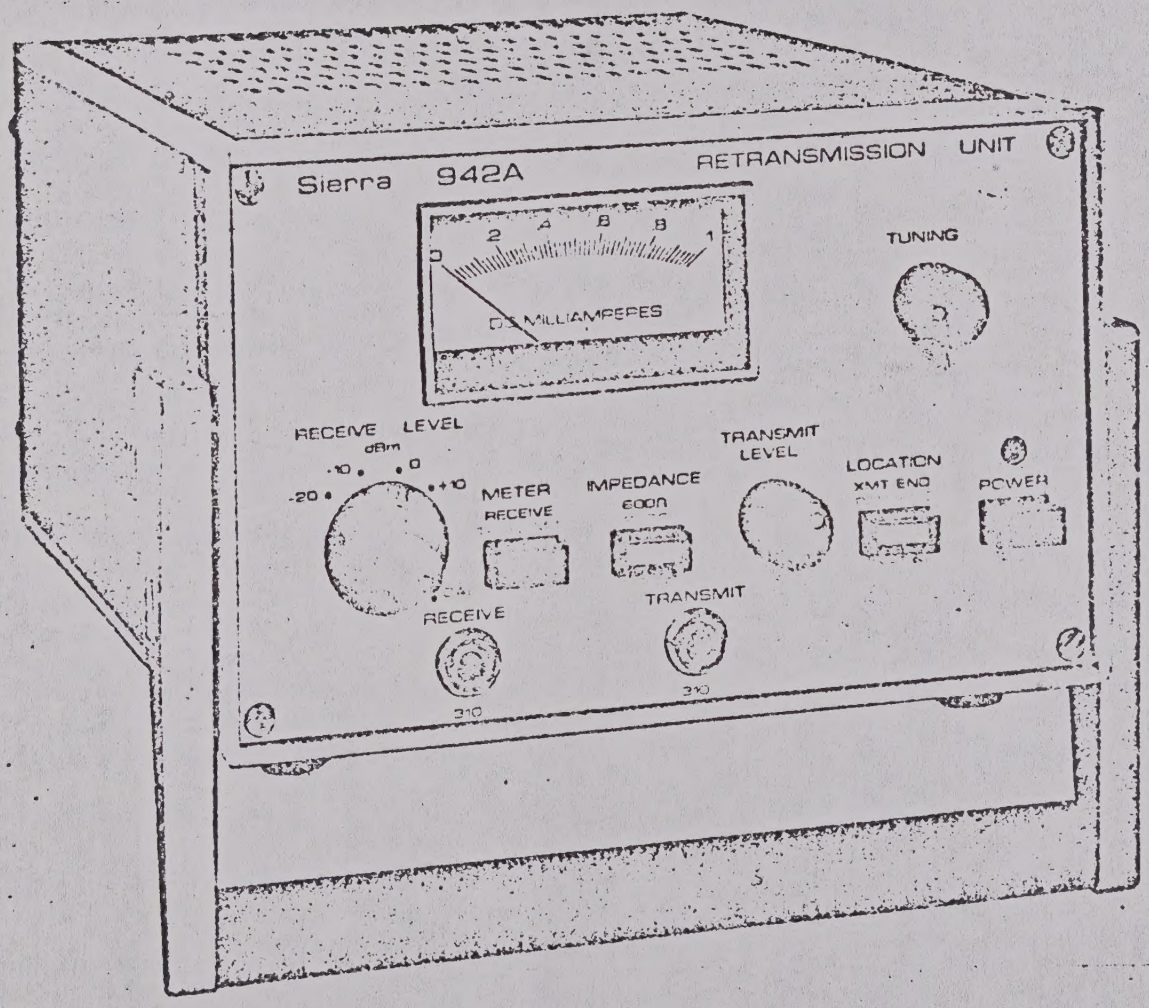

Figure 1. Sierra 942A Retransmission Unit

SIERRA OPERATION MANUAL

942A RETRANSMISSION UNIT
DESCRIPTION AND OPERATION

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1. GENERAL

1.01 This manual describes the Sierra 942A Retransmission Unit (Figure 1) and how to use it. Included are specifications, simplified diagrams, and maintenance instructions at the operator level. For calibration or repair, refer to operation/maintenenace manual SMM-942A.

1.02 The Sierra 942A is a low-cost instrument designed for line conditioning measurements (relative envelope delay and amplitude) on voice frequency data transmission circuits. It is used at the remote end of the circuit under test in lieu of the multi-function Sierra 940A Line Conditioning Test Set, or a comparable instrument. At the measurement point, delay and amplitude characteristics are read on the 940A.

1.03 Simplified diagrams of three basic types of testing are shown in Figure 2. On the diagrams and throughout this manual, the remote ends of the circuit under test are called transmit point or receive point, respectively, according to whether the swept carrier (with modulation of 25 Hz or 83-1/3 Hz) is transmitted or received.

1.04 When used at the receive point, the 942A retransmits delay and amplitude information about the circuit under test back to the measurement point. The information is sent over the return reference line as modulation on a fixed carrier. Except during initial setup, all adjustments are made on the 940A at the measurement point.

1.05 When used at the transmit point, the 942A receives modulation over the forward reference line on a fixed carrier and retransmits it on a swept carrier over the circuit under test. In this direction, the carrier

can be tuned manually to a single frequency or swept automatically over the frequency band of interest. There are two optional versions of the 942A, which differ in the way the carrier frequency is controlled.

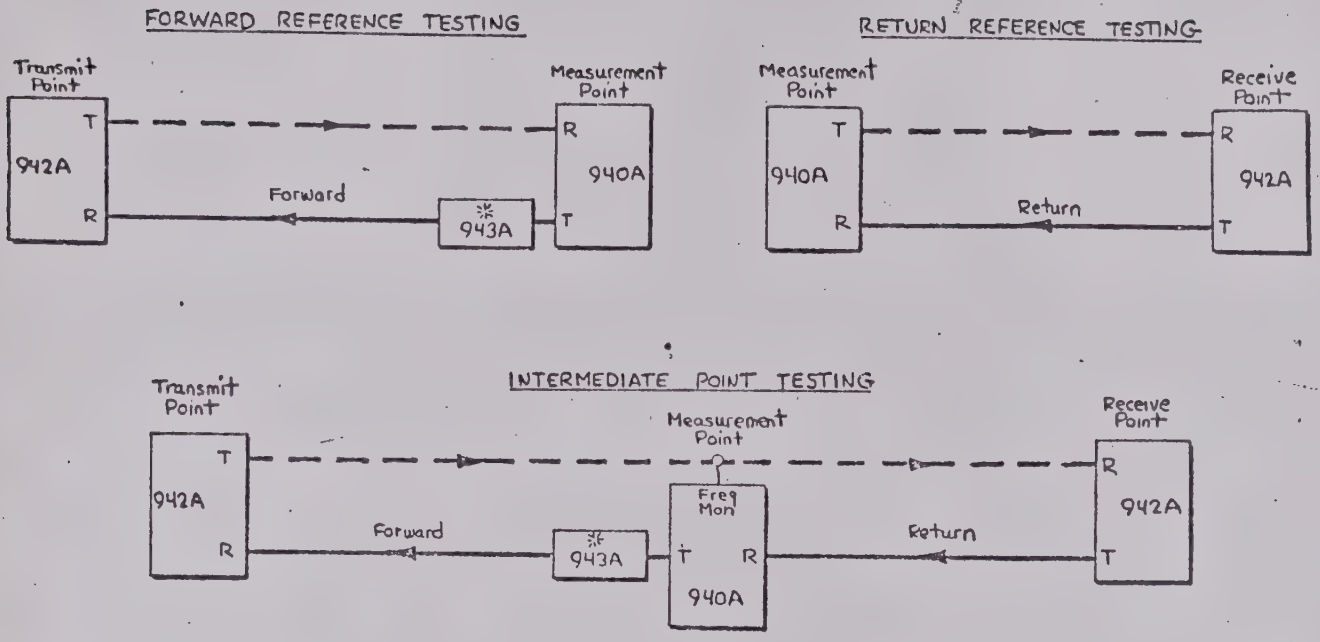
(a) 942A-1 Retransmission Unit. Carrier is tuned by a 943A Remote Control Unit at the measurement point. The 943A sends a level-controlled signal over the forward reference line to the transmit point, where the 942A-1 converts the level variations on the receive signal to frequency variations on the transmit signal.

(b) 942A-2 Retransmission Unit. Carrier is tuned on the 942A-2, manually or automatically over a preset sweep time and frequency range.

1.06 Modification kits are available for converting one type of 942A to the other type.

(a) Modification Kit 942A-01. Converts 942A-2 to 942A-1.

(b) Modification Kit 942A-02. Converts 942A-1 to 942A-2.



Notes:

Swept carrier on circuit under test ——▶——

Fixed carrier on reference line ◀——

※ 943A at measurement point works with 942A-1 at transmit point. If 943A is not used, transmit point requires 942A-2.

Figure 2. Basic Test Circuit Diagrams

2. PHYSICAL DESCRIPTION

2.01 The retransmission unit is a lightweight, portable instrument that uses solid-state components, mostly integrated circuits. Input and output circuits are accessible through front panel telephone jacks (for type 310 plugs) or parallel rear panel banana jacks. A front panel meter reads transmit and receive signal levels on 600-ohm or 900-ohm lines. Screwdriver controls for presetting sweep time and range are on the rear panel (942A-2 only). The rear panel also has an ac power input receptacle (a 6-foot power cord is furnished), an ac line fuse, and a switch for selecting 115V or 230V operation.

PART OF SHIPPING UNIT — SEND ALONG IN SHIP. AUX WITH UNIT.

2.02 Accessories for the 942A unit are a Bench Model Kit (A02938200) with a combination handle and tilt-up stand and a Rack Mounting Kit (A02838500) for a 19-inch equipment rack. Both kits include all necessary hardware.

2.03 Operating controls and indicators on the front panel and rear panel are identified in Figures 3 and 4 and described in Tables 1 and 2.

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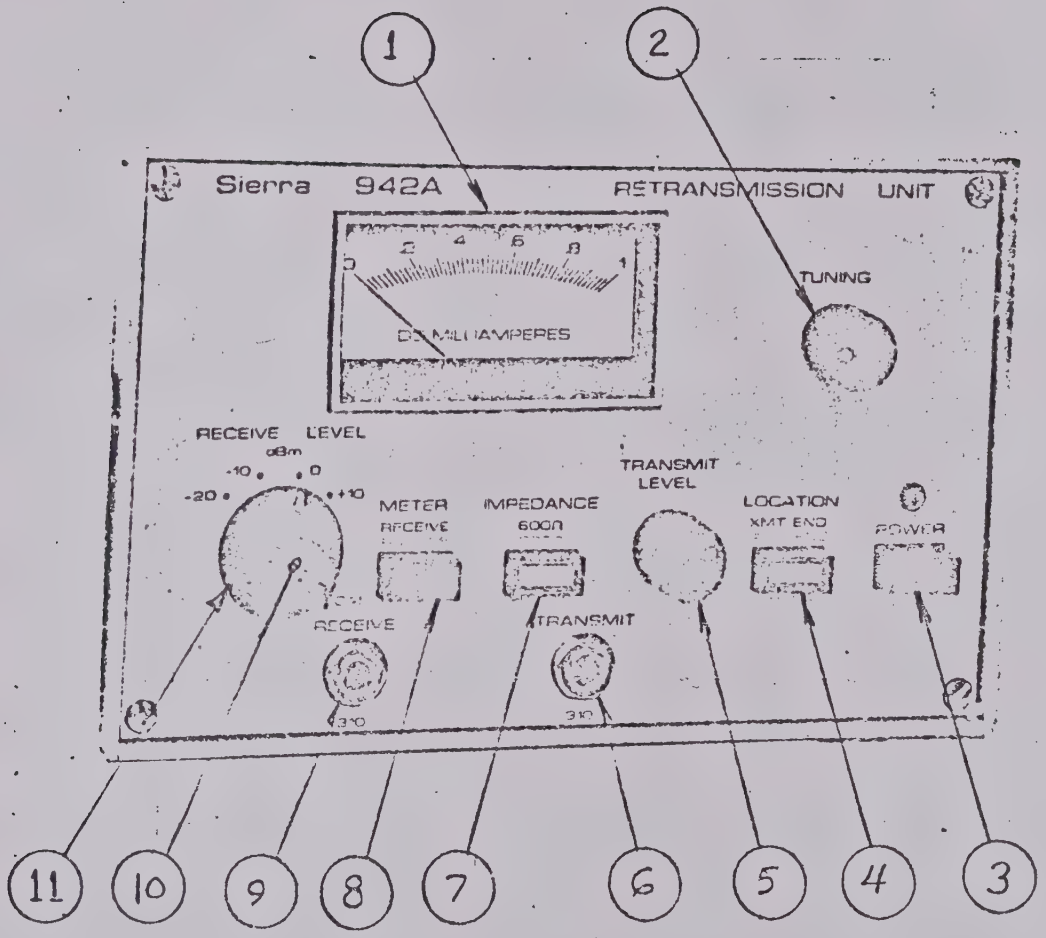

Figure 3. Front Panel Controls and Indicators

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Table 1. Front Panel Controls and Indicators

FIG. INDEX NO.	NAME	FUNCTION
1	LEVEL meter	Indicates transmit or receive level; also, see (8) and (10). (RCV END)
2	TUNING control	Adjusts transmit frequency between 0.2 and 4 kHz; on 942A-1, ~~LOCATION switch must be in RCV END position and a~~ receive signal (~~-6 dB on LEVEL meter~~) is required; ~~on~~ 942A-2, ~~LOCATION switch must be in~~ XMT END position ~~and~~ XMT END switch (rear panel) in MAN. position. (ALSO ADJUSTS)
3	POWER switch	Turns ac power on and off; pushbutton.
4	LOCATION switch (SELECTS MODE OF OPERATION OF UNIT; RCV END ALLOWS RETRANSMISSION OF RECEIVED SIGNAL OVER A FIXED CARRIER FREQUENCY. XMT END ALLOWS RETRANSMISSION OF MODULATION AT A FIXED LEVEL OVER A MANUAL, SWEPT OR REMOTE CONTROLLED CAL FREQUENCY)	Selects method of tuning transmit frequency (manual, sweep, or remote) that is appropriate to location of 942A at transmit point or receive point; pushbutton.
5	TRANSMIT LEVEL control	Adjusts transmit level over range of -20 to +2 dBm; ten-turn potentiometer.
6	TRANSMIT jack	Transmit output; mates with tip-ring-sleeve telephone plug, type 310.
7	IMPEDANCE switch	Selects input and output (receive and transmit) impedances; pushbutton.
8	METER switch	Normally connects metering circuit to indicate receive input level; when pushed in, transfers transmit output signal to metering circuit; ~~non-locking~~ pushbutton. (MOMENTARY)
9	RECEIVE jack	Receive input; mates with tip-ring-sleeve telephone plug, type 310.
10	RECEIVE LEVEL vernier	Fine adjusts receive level reading on LEVEL meter; adjustment range is from -10 dB (ccw) to 0 dB (CAL); in CAL position of vernier, meter reads receive level in dBm.
11	RECEIVE LEVEL switch	Selects one of four receive level ranges.

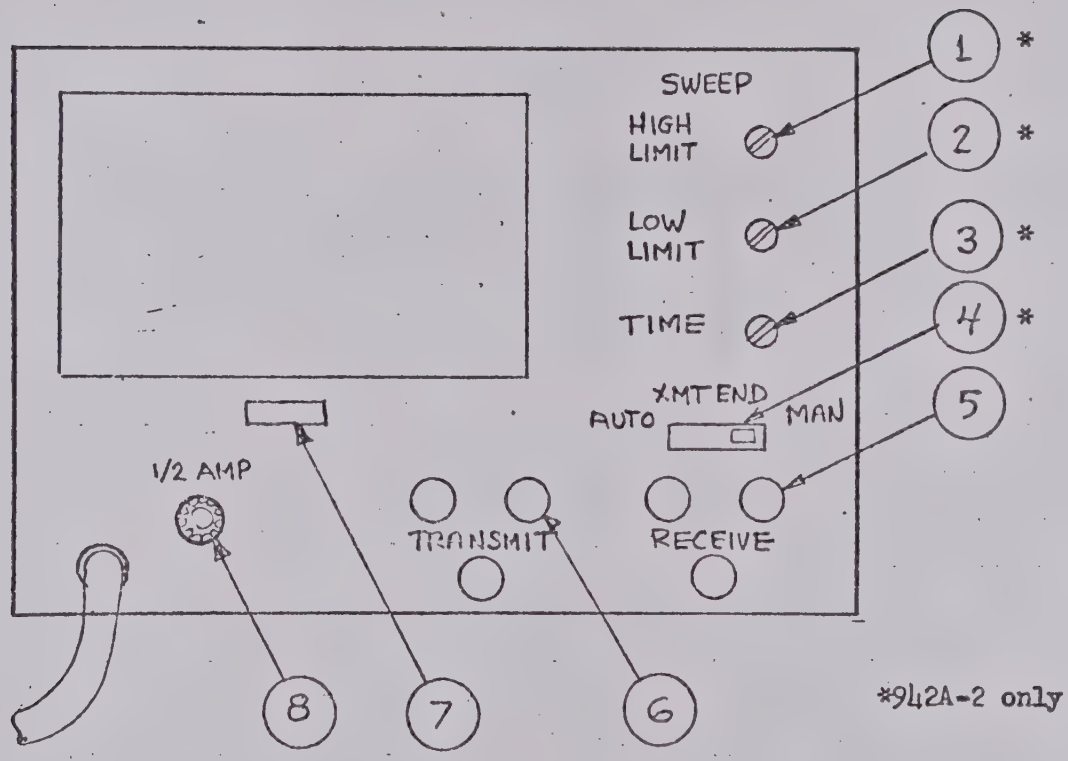


Figure 4. Rear Panel Controls

Table 2. Rear Panel Controls

FIG. INDEX NO.	NAME	FUNCTION
*1	SWEEP HIGH LIMIT control	Sets upper limit of transmit frequency sweep; ten-turn potentiometer with screwdriver adjustment.
*2	SWEEP LOW LIMIT control	Sets lower limit of transmit frequency sweep; ten-turn potentiometer with screwdriver adjustment.
*3	SWEEP TIME control	Sets time of transmit frequency sweep (up or down) between 1 and 30 seconds; ten-turn potentiometer with screwdriver adjustment.
*4	XMT END switch	Selects continuous sweep up and down (AUTO) or manual tuning (MAN) of transmit frequency; two-position slide switch.
5	RECEIVE terminals	Receive input; green (tip) and red (ring) terminals are balanced input and black terminal is chassis ground; paralleled with jack on front panel.
6	TRANSMIT terminals	Transmit or retransmit output; green (tip) and red (ring) terminals are balanced output and black terminal is chassis ground; paralleled with jack on front panel.
7	115/230 switch	Adapts 942A for 115V or 230V ac power input; slide switch.
8	AC Power Fuse	Overload protection for ac power input.

*942A-2 only

3. FUNCTIONAL DESCRIPTION

3.01 Figure 5 is a block diagram of the 942A Retransmission Unit. By closing the paths through arrowheads designated by circled -1's or -2's, the diagram represents either 942A-1 or 942A-2.

Retransmit Circuit

3.02 On the retransmit path through the 942A, emphasized in Figure 5 by a heavy line, incoming signals enter at the front panel RECEIVE jack, which is terminated in 600 ohms or 900 ohms by IMPEDANCE switch S3. An isolation transformer and 10-dB pad are followed by a buffer amplifier, RECEIVE LEVEL controls, and a 30-dB amplifier. RECEIVE LEVEL switch S1 adjusts the step attenuator to accommodate signals in the -40 dBm to +12 dBm range. When the 942A is retransmitting, the vernier is adjusted for a LEVEL meter reading of -6 dB; this calibration of the receive signal provides 50% modulation of the transmit signal. The meter reading (-10 to +2 on the meter scale) indicates the level in dBm at the output of the 30-dB amplifier, regardless of the RECEIVE LEVEL switch setting.

3.03 As explained later, level variations in the receive signal from a distant 943A Control Unit are converted by the 942A-1 to frequency variations in the retransmitted signal. To compensate for the varying level, an agc (automatic gain control) circuit is inserted in the main signal path of the 942A-1 when the LOCATION switch S3 is in XMT END position. The agc circuit is able to follow the fastest rate of level change used (sweep rate) but it ignores level changes at vf carrier frequency rates.

3.04 An envelope detector recovers the modulation frequency (25 Hz or 83-1/3 Hz) plus a dc component from the receive signal; vf carrier is blocked by a 125-Hz lowpass filter. Through a buffer amplifier, this varying dc voltage is applied to a 25-kHz balanced modulator. When S3 is in RCV END, the dc component determines carrier level, ~~or average modulation level~~. In applications where S3 is in XMT END ~~and no carrier is received~~, the modulator input is deliberately unbalanced by a resistor to ground through S3 so that the modulator has a dc input and a steady 25-kHz output. If a modulated carrier is received, ~~the modulation frequency goes through the capacitor and the dc component (now not needed) is blocked.~~

3.05 From the modulator, carrier and sidebands go through a converter that translates the signal down to the 0.2 to 4.0 kHz band. An 11-kHz lowpass filter blocks all but the desired vf carrier and sidebands resulting from the 25-Hz or 83-1/3 Hz modulation, as applicable.

3.06 An amplifier with gain adjustable by the TRANSMIT LEVEL control sets the transmit signal at the required level in the -20 to +2 dBm range. After the balancing transformer, output impedance is built out to 600 ohms or 900 ohms by IMPEDANCE switch S2. The transmit signal is available at a front panel jack or at terminals on the rear panel.

Metering Circuit

3.07 The metering circuit consists of a detector (rectifier), dc amplifier, and the LEVEL meter. Through METER switch S1, the circuit is normally connected to the receive branch. Pushing the non-locking switch in to the TRANSMIT position disconnects and terminates the outgoing signal and connects the metering circuit across the termination to indicate transmit level.

Transmit Frequency

3.08 The frequency of the vf transmit carrier is established in the converter by the frequency of a Voltage-Controlled Oscillator (VCO). Control voltage to the VCO comes from one of three sources selected by LOCATION switch S3 and XMT END switch S1.

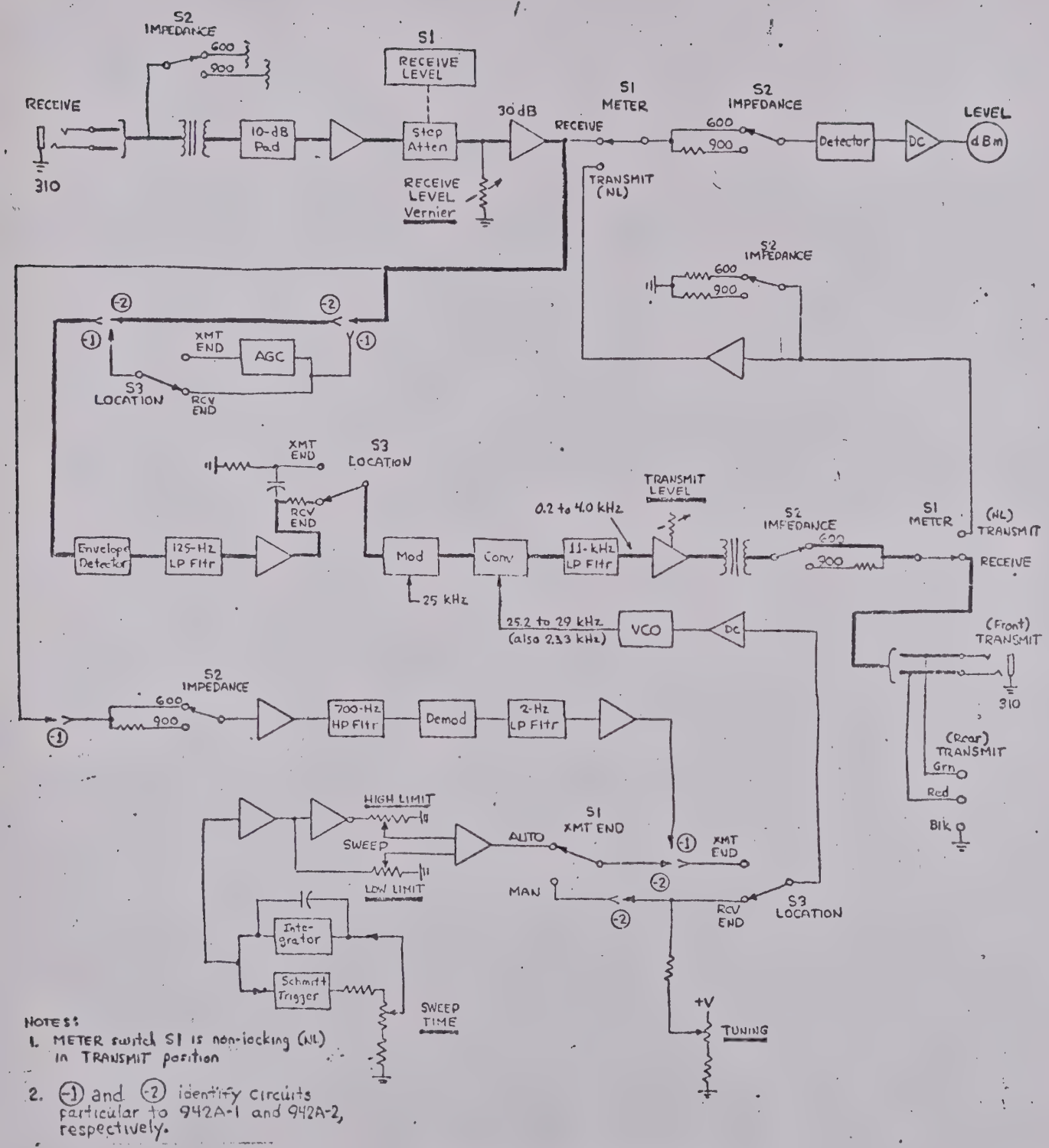
3.09 942A-1 or -2 With S3 in RCV END. If a signal is being received, with or without modulation, 25-kHz carrier will appear at the converter input. Now, dc voltage from the TUNING control can vary the VCO frequency between 25.2 and 29 kHz and the resultant transmit frequency will be between 0.2 and 4.0 kHz. Without any incoming signal, there will be no 25-kHz input to the converter and no transmit signal.

3.10 942A-1 With S3 in XMT END. On A branch circuit from the main path, the receive signal goes through switch S2, an amplifier, and a 700-Hz highpass filter to the demodulator. The rectified signal from the demodulator continues through a 2-Hz lowpass filter and a dc amplifier to the VCO. By this means, the signal level from the distant 943A Control Unit establishes the frequency transmitted by the 942A-1. With a -6 dB reading on the LEVEL meter, the vco output is 26.7 kHz and the converter output is 1700 Hz. The range of levels

between -11 dB and -1 dB (on the meter scale) results in 25.2 to 29 kHz at the vco output and vf transmit carrier frequencies between 0.2 and 4.0 kHz. If there is no input signal, the control voltage decreases to almost zero. The resultant vco frequency drops to 23.3 kHz and the vf transmit carrier becomes 1700 Hz.

3.11 942A-2 With S3 in XMT END and S1 in MAN. The vf transmit carrier frequency is adjustable between 0.2 and 4.0 kHz by the TUNING control and does not depend on a receive signal. As explained previously, a deliberate dc unbalance is created at the modulator input to cause a 25-kHz output to the converter.

3.12 942A-2 With S3 in XMT END and S1 in AUTO. Sweep voltage to the vco is generated as a triangular waveform by an integrator and Schmitt trigger connected in a closed loop. The period of the waveform is adjustable between 2 and 60 seconds by the SWEEP TIME control. Peak voltages of the waveform, set independently by the HIGH LIMIT and LOW LIMIT controls, determine the sweep frequency range.



NOTES:

1. METER switch S1 is non-locking (NL) in TRANSMIT position
2. -1 and -2 identify circuits particular to 942A-1 and 942A-2, respectively.

Figure 5. Retransmission Unit Block Diagram

4. SPECIFICATIONS

4.01 Specifications of the 942A are given in Table 3.

Table 3. 942A Retransmission Unit Specifications

PARAMETER	CHARACTERISTIC
Carrier Frequency	
Range	0.2 to 4.0 kHz unmodulated or with 25 or 83-1/3 Hz 50-percent amplitude modulation
Response	±0.2 dB with reference to 1 kHz
Level	
Receive Level Range	-40 to +12 dBm in four 10 dB steps
Transmit Level Range	-20 to +2 dBm
Meter Calibration	-20 to +2 dBm
Measurement Accuracy at 1 kHz	±0.5 dB from -10 to +2 dBm; ±0.7 dB from -20 to -10 dBm
Impedance	600 or 900 ohms, ±3%, terminated, balanced
Transmit Output With No Receive Signal	
Frequency, 942A-1	1700 Hz ±100 Hz
Frequency, 942A-2	Adjustable, 0.2 to 4.0 kHz
Modulation	None
Level	-20 to +2 dBm
Receive Level to Transmit Frequency Conversion by 942A-1	
-6 dB	1700 Hz ±10%
-10.5 dB ±1 dB	200 Hz
-1.5 dB ±1 dB	4000 Hz
Retransmission Linearity of 942A-1	±0.2 dB, -4 to +2 dBm; ±0.4 dB, -10 to -4 dBm (reference, 0 dBm at 1700 Hz)
Sweep Time Up or Down, 942A-2	Adjustable, 1 to 30 seconds

Table 3. 942A Retransmission Unit Specifications (cont)

PARAMETER	CHARACTERISTIC
Common Mode Rejection	50 dB minimum
Input Protection	500 Vdc, each balanced terminal to ground; 150 volts peak for 50 ms between balanced terminals
Temperature Range	
Operating	32° to 122°F (0° to 50°C)
Storage	-4° to 117°F (-20° to 65°C)
Power	115 or 230 Vac ±10%, 48 to 420 Hz, 25 VA
Size	
Height	5-1/4 inches (13.3 cm)
Width	8-3/8 inches (21.3 cm)
Depth	12 inches (30.5 cm)
Weight	15 pounds (6.8 kilograms)

5. OPERATION

Receiving Information

5.01 When the 942A is received, unpack it and inspect it carefully for damage. Keep the shipping carton. Check the equipment received against the order. A standard three-wire power cord is furnished; test cords can be ordered separately.

5.02 To ensure that the 942A is in good working condition, it should be checked out by performing the procedure of paragraph 6.03. If the unit is damaged or does not operate properly, contact the Customer Service Department for instructions.

ADDRESS: Customer Service Department
Sierra Electronic Operation
Philco-Ford Corporation
3885 Bohannon Drive
Menlo Park, California 94025

Telephone (415) 322-7222
TWX 910-373-1282

NOTE: Do not repackage damaged or faulty equipment for reshipment to Sierra Electronic Operation under the provisions of the Warranty without first contacting Sierra for specific instructions.

Bench Model Kit

5.03 If the Bench Model Kit (A02838200) is to be added to the 942A unit, the following procedure should be used. Assembly is shown in Figure 6.

Step 1
Remove adhesive-backed strips (1) from left and right sides of unit.

Step 2
Place locking device (2) over center hole on right side of unit. The square portion will fit into the channel on the unit.

Step 3
Align hole on arm (3) with hole on locking device and secure with shoulder screw.

Step 4
Repeat steps 2 and 3 for the left-side arm attachment.

Step 5
Attach 8-inch handle (4) between arms with flathead screws.

Step 6
Place adhesive-backed cover (5) over outside of each arm.

Step 7
Install four rubber feet (6) on bottom of unit.

Step 8
Attach two adhesive-backed strips (7) to each side of unit in place of strips removed in step 1.

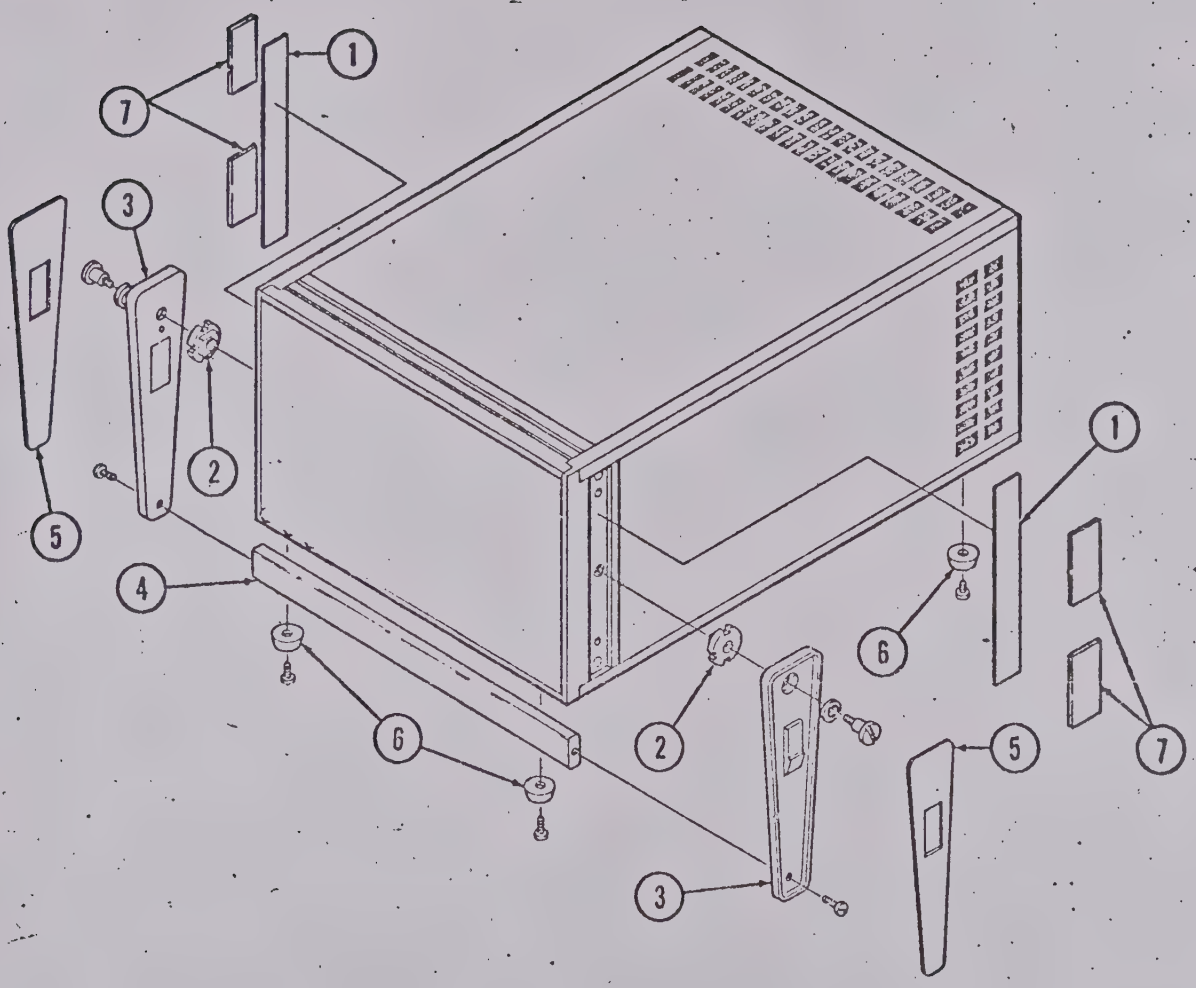


Figure 6. How to Assemble the Bench Model Kit

Rack Mounting Kit

5.04 If the 942A unit is to be mounted on a standard 19-inch equipment rack, install Rack Mounting Kit (A02838500) using the following procedure. See Figure 7.

Step 1
Remove adhesive-backed strips (1) from left and right sides of unit.

Step 2
Connect right-angle brackets (2) to each side of unit.

Step 3
Remove feet from bottom of unit.

NOTE: Figure 7 shows unit on left side of rack. For right-side location, install blank panel (3) and spacer plate (4) on left side of unit.

Step 4
Connect spacer plate (4) to blank panel (3).

Step 5
Attach spacer plate (4) to right-angle bracket (2).

Step 6
Unit is now ready for rack mounting.

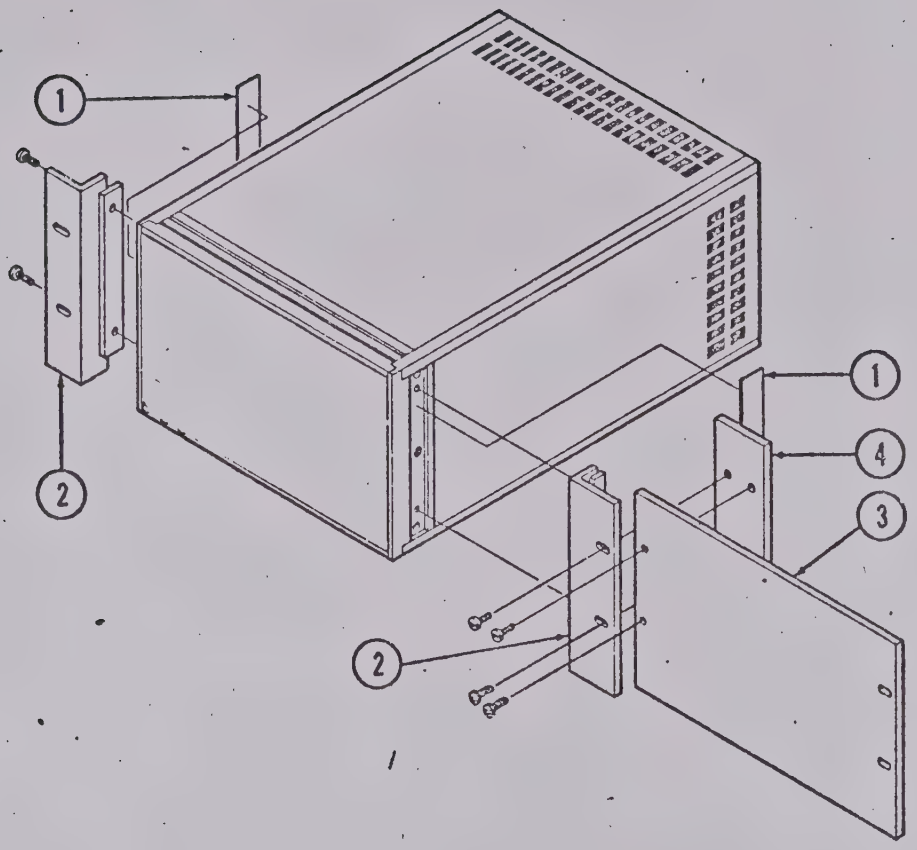


Figure 7. How to Attach the Rack Mounting Kit

Power Turn-On

5.05 For all applications, the test equipment must be connected to a 115-volt or 230-volt ac power source of 48 to 420 Hz.

CAUTION: For 230-volt operation, the 115/230 switch on the rear panel must be in the 230 position. Otherwise, the test equipment will be damaged when power is turned on.

Step 1
Connect ac line receptacle on rear panel to ac power source.

Step 2
On 940A test set only, turn DELAY RANGE switch to OFF and METER switch to TRANSMIT LEVEL.

Step 3
Set POWER switch to ON and allow equipment to warm up for about 15 minutes.

Level Readings

5.06 In the operating procedures, references are made to ~~dB~~ LEVEL meter readings. Unless otherwise specified, this means the algebraic sum of the setting of the TRANSMIT LEVEL switch (940A test set only) or RECEIVE LEVEL switch, as selected by the METER switch, and the reading on the meter scale. For example, a switch setting of -10 and a meter scale reading of +2 would be a level of -8 dB. (See next paragraph for dBm.) When a reading on the meter scale is specified, the switch setting is to be disregarded.

5.07 If the circuit connected to the test equipment has a characteristic impedance that agrees with the setting of the IMPEDANCE switch, then transmit levels on the circuit, as read on the 940A or 942A, will be in dBm.

For receive levels to be in dBm, there is the additional requirement that the RECEIVE LEVEL vernier be in CAL position.

Presetting Sweep Controls on 942A-2

5.08 In the following procedure, the sweep frequency limits and sweep time of the 942A-2 unit are preset to the required values using the rear panel screwdriver controls. The output of the 942A-2 is sent over a vf circuit to another location where frequency is measured on a 940A test set. Instead, frequency could be measured locally on a 940A test set or an electronic counter. If the sweep characteristics of the 942A-2 are being adjusted as part of the test procedure in Table 7 or Table 9, begin at step 9.

Step 1
Turn on test equipment as described in paragraph 5.05.

Step 2
Set controls on 940A as follows:

FUNCTION switch to MEASURE
IMPEDANCE switch as applicable
METER switch to RECEIVE LEVEL
FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL

Step 3
Set controls on 942A-2 as follows:

LOCATION switch to XMT END
XMT END switch (rear panel) to MAN
IMPEDANCE switch as applicable

Step 4
Connect TRANSMIT on 942A-2 to RECEIVE on 940A, directly or through the vf circuit between locations.

Step 5
On the 942A-2, push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit test tone level of vf circuit.

Step 6
Adjust TUNING control on 942A-2 for FREQUENCY display on 940A of test tone frequency for vf circuit.

Step 7
On 940A, adjust RECEIVE LEVEL switch and vernier for an on-scale meter reading.

Step 8
Set XMT END switch on 942A-2 to AUTO.

Step 9
If necessary, turn SWEEP TIME control on 942A-2 clockwise to slow sweeping enough for frequency limits to be noted.

Step 10
Adjust HIGH LIMIT and LOW LIMIT controls to establish the required sweep frequency range.

Step 11
Adjust SWEEP TIME control as required. Total sweep time can be determined most easily by timing the interval between successive readings of the highest or lowest frequency.

Circuit Loss Measurement

5.09 In the procedures of Table 4, circuit loss is measured between a local point equipped with a 940A Line Conditioning Test Set and a remote point equipped with a 942A Retransmission Unit. Loss is measured in both directions of the four-wire circuit, forward and return. At the remote point, the transmit carrier is tuned on the 942A while its frequency is monitored on the 940A at the local point. ~~Craftsmen at each location must be in contact over another circuit.~~ TOO MUCH SPACING

5.10 At the remote point, either a 942A-1 or -2 may be used to measure the receive signal level and to generate the transmit signal. The transmit signal frequency of both units can be manually tuned over the vf band. However, one difference in the two types of units is that the 942A-1 must be receiving a signal; otherwise, its transmit output is fixed at 1700 Hz.

Line Conditioning Measurements

5.11 Line conditioning means equalization of a data transmission circuit to compensate for variations in relative delay and relative amplitude over the vf frequency range. Line conditioning measurements are covered in Tables 5 through 9 with associated test setups in Figures 9 through 13. These procedures use three basic types of testing: return reference, forward reference, and intermediate point. In each type, the circuit under test must have a parallel line in the other direction of transmission; ~~also, a voice communications circuit between the test equipment locations is required for use by the craftsman in coordinating the testing.~~

5.12 Return Reference Testing. In return reference testing, in a 940A Line Conditioning Test Set at the local measurement point, a swept carrier is modulated with 25 Hz or 83-1/3 Hz and sent over the circuit under test. In a 942A Retransmission Unit at the remote receive point, the modulation is re-

covered by an envelope detector and applied to a fixed carrier that is transmitted to the local point via the return reference line. Because the carrier frequency is fixed, varying delay and amplitude information acquired on the forward transmission, and contained in the modulation, is altered uniformly on the return trip; the relative values over the frequency range do not change. Delay and amplitude characteristics of the circuit under test are read on the 940A.

5.13 Forward Reference Testing. From a 940A at the local measurement point, modulation on a fixed carrier is transmitted over the forward reference line to a 942A at the remote transmit point. There, the modulation is recovered and applied to a swept carrier that is transmitted to the local point over the circuit under test. Again, delay and amplitude characteristics are read on the 940A

5.14 The 942A-1 and -2 units use different techniques for sweeping the transmit carrier frequency. With the 942A-1 at the transmit point, a 943A Control Unit at the measurement point sweeps the level of the outgoing carrier; the 942A-1 converts these receive level variations to transmit frequency variations on the circuit under test. In contrast, the 942A-2 at the transmit point has its own sweep generator with rear panel screwdriver controls for presetting the sweep rate and frequency limits. Continuous up and down sweeping is initiated when the rear panel XMT END switch is operated to AUTO.

5.15 Intermediate Point Testing. When an adjustable equalizer is at an intermediate location in a transmission line, intermediate point testing enables the effect of an equalizer adjustment to be immediately apparent to the craftsman. This type of testing is a combination of the two types just described: forward reference and return reference. From the measurement point, modulation travels on a fixed carrier over a forward reference line to the transmit point.

There, the modulation is retransmitted on a swept carrier over the circuit under test to the receive point. Modulation containing delay and amplitude information is returned on a fixed carrier to the measurement point where circuit characteristics are read on the 940A.

5.16 Delay Reference Set. As a preliminary step in delay measurement, the DELAY REF SET button on the 940A test set is pushed while the test set is receiving the zero-delay reference frequency. This synchronizes the local timing pulse with the phase of incoming modulation and causes the DELAY meter to read zero. If the reference line or circuit under test is interrupted during frequency sweeping, the delay reference must be reset on the 940A as in the preliminary step described above.

PRELIMINARY

Table 4. Circuit Loss Measurement

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment (Figure 8) as described in paragraph 5.05.	
2	Connect test equipment as shown in Figure 8.	
	MEASUREMENT POINT	TRANSMIT/RECEIVE POINT
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to OFF IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to OFF FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL RECEIVE LEVEL vernier to CAL METER switch to TRANSMIT LEVEL	
4	Adjust MANUAL TUNING control for FREQUENCY display of test tone frequency, in example 1004.	
	NOTE: If the forward circuit impedance is a poor match to the output impedance of the test set, in setting the transmit level in the next step, temporarily disconnect the forward circuit and connect a 600- or 900-ohm (as applicable) resistor termination to the TRANSMIT terminals, or loop TRANSMIT terminals to RECEIVE.	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit level for forward circuit.	
6 - Turn METER switch to RECEIVE LEVEL.		
7		Set controls on 942A as follows: LOCATION switch to RCV END (~~-1~~) or XMT END (-2) IMPEDANCE switch as applicable RECEIVE LEVEL vernier to CAL ~~On 942A-2 only, XMT END switch (rear panel) to MAN~~

Table 4. Circuit Loss Measurement (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT/RECEIVE POINT
8		Adjust RECEIVE LEVEL switch for an on-scale LEVEL meter reading.
9		To determine forward circuit loss, algebraically subtract transmit level in step 5 from receive level in step 7. (A minus remainder is a loss, a plus is a gain.)
10		Adjust RECEIVE LEVEL vernier for -6 dB on LEVEL meter scale.
10	Turn METER switch to RECEIVE LEVEL.	
11		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for return circuit.
12		Adjust TUNING control on 942A for FREQUENCY display on 940A at measurement point of test tone frequency.
13	Adjust RECEIVE LEVEL switch for an on-scale LEVEL meter reading.	
14	To determine return circuit loss, algebraically subtract transmit level in step 11 from receive level in step 13.	

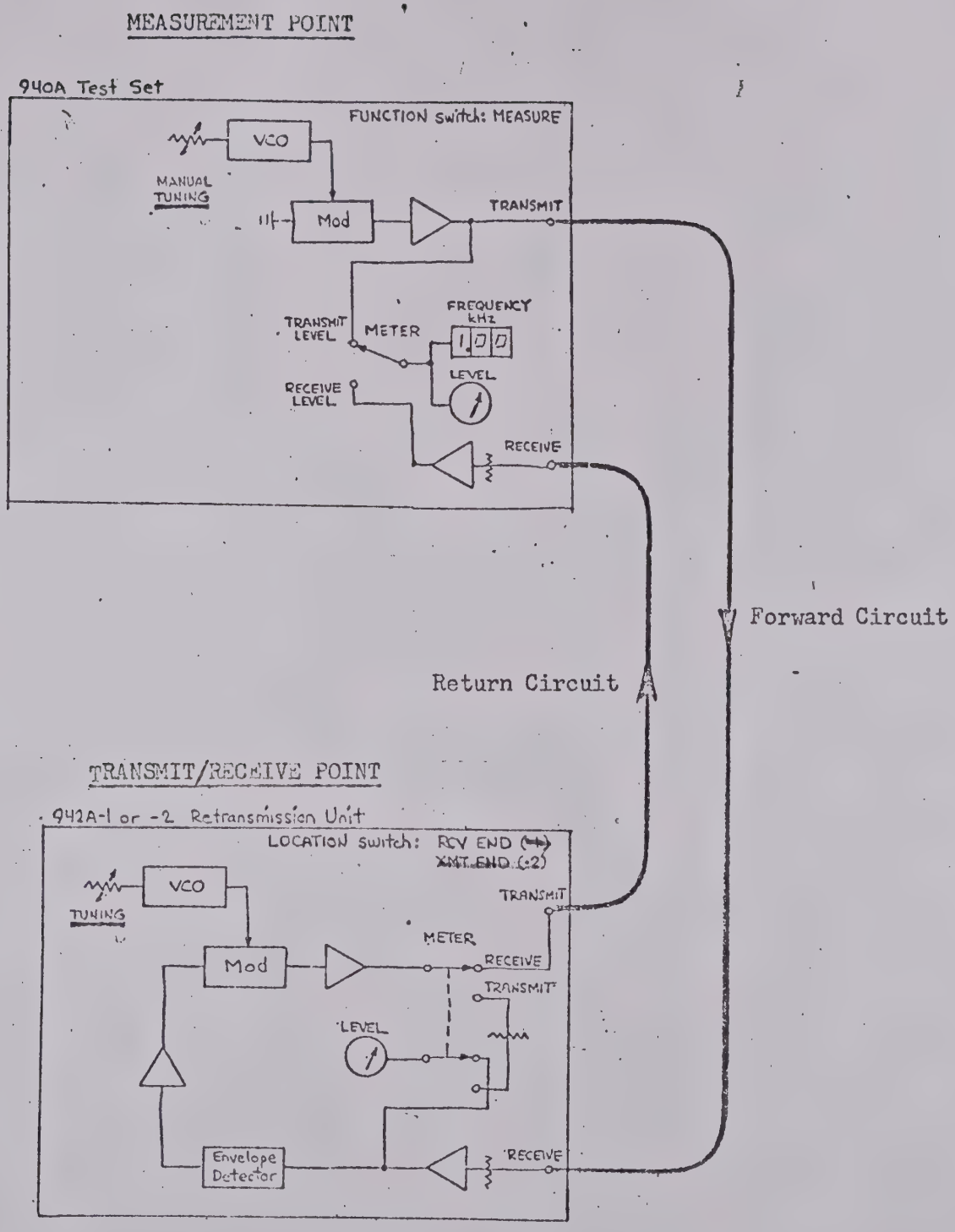


Figure 8. Circuit Loss Measurement

Table 5. Return Reference Testing With 942A-1 or -2 at Receive Point

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment (Figure 9) as described in paragraph 5.05.	
2	Connect test equipment as shown in Figure 9.	
	MEASUREMENT POINT	RECEIVE POINT
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL SWEEP TIME STEP switch to 1/4 sec SWEEP TIME FINE control to CAL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
4	Adjust MANUAL TUNING control for FREQUENCY display of zero-level reference frequency for circuit under test, For Example, 1000 Hz.	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit level for circuit under test.	
6		
7		Set controls on 942A as follows: LOCATION switch to RCV END IMPEDANCE switch as applicable
8		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
9		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for return reference line.
10	Turn METER switch to RECEIVE LEVEL.	

Table 5. Return Reference Testing With 942A-1 or -2 at Receive Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
10		Adjust TUNING control on 942A for FREQUENCY display on 940A at measurement point of test tone frequency for return reference line (typically, 1.80 kHz).
11	Adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
	Set function switch to MEAS REF SET AND	
12	Adjust MANUAL TUNING control for FREQUENCY display of zero-delay reference frequency for circuit under test (Typically 1.74 Hz or 1.8 kHz).	
13	Push DELAY REF SET button. DELAY meter should read 0 μs.	
14	Turn DELAY RANGE switch to 90. DELAY meter should read 0 ±2 μs.	
15	Turn TUNING MODE switch to SINGLE SWEEP and METER switch to TRANSMIT LEVEL.	
16	Adjust SWEEP LIMITS LOW control for FREQUENCY display of lowest frequency in band of interest. (If adjustment doesn't affect frequency, push START button and then adjust the control.)	
17	Push START button.	
18	Adjust SWEEP LIMITS HIGH control for FREQUENCY display of highest frequency in band of interest.	
19	Turn TUNING MODE switch to SWEEP.	
20	Set SWEEP TIME STEP switch and FINE control for desired sweep time.	

Table 5. Return Reference Testing With 942A-1 or -2 at Receive Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
21	Turn METER switch to RECEIVE LEVEL.	
~~22~~ 21	Adjust DELAY RANGE switch for optimum DELAY meter readings over the swept band.	
~~23~~ 22	Record level and delay information as required.	

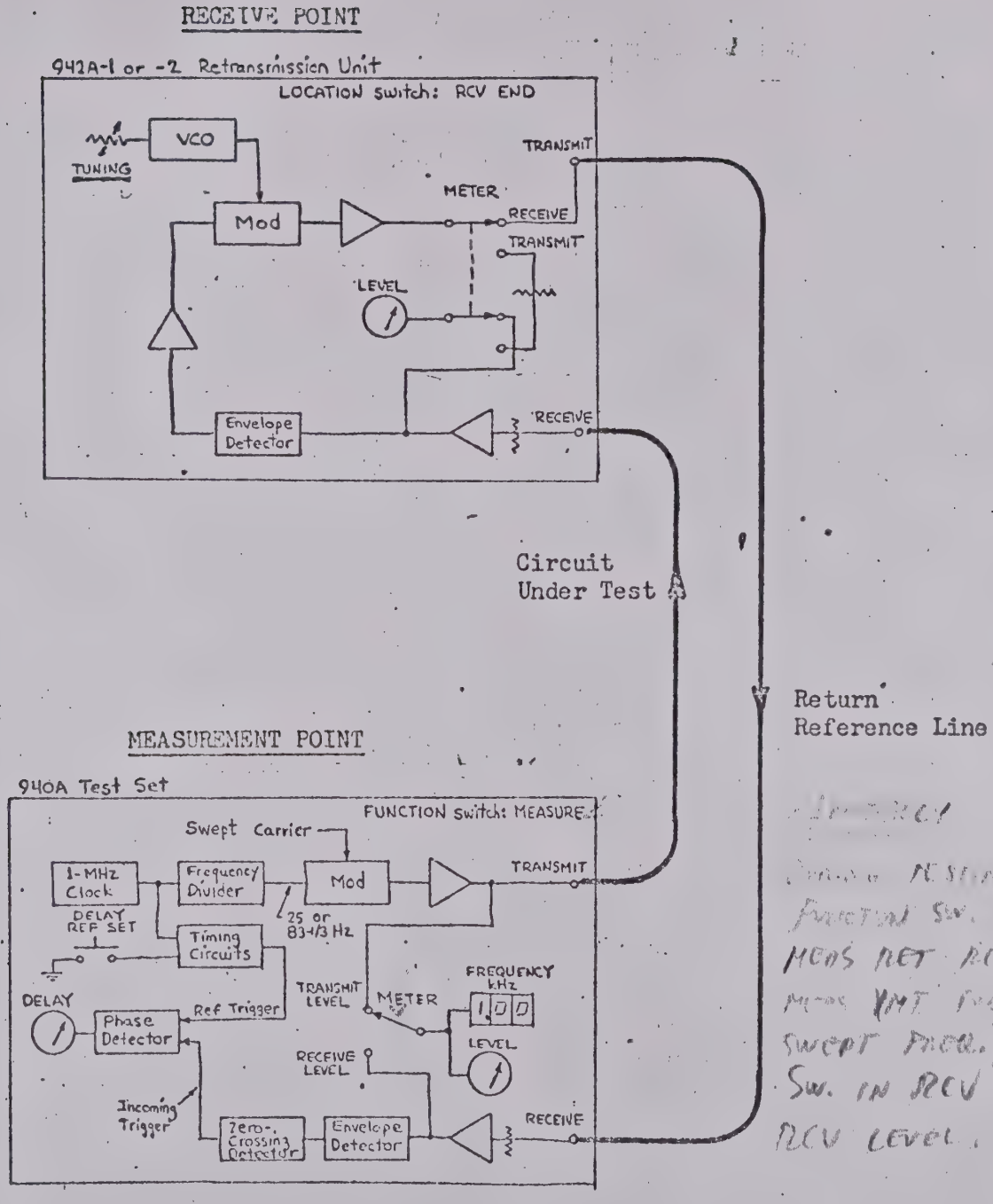


Figure 9. Return Reference Testing With 942A-1 or -2 at Receive Point

Table 6. Forward Reference Testing With 942A-1 at Transmit Point

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment (Figure 10) as described in paragraph 5.05.	
	MEASUREMENT POINT	TRANSMIT POINT
2	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
3	Connect TRANSMIT and RECEIVE on 940A to RECEIVE and TRANSMIT, respectively, on 943A.	
4	Set controls on 943A as follows: IMPEDANCE switch as applicable (same as 940A) TUNING MODE switch to REFERENCE	
5	Adjust MANUAL TUNING control on 940A for FREQUENCY display of 1.70 kHz.	
6	Adjust TRANSMIT LEVEL switch and vernier on 940A for LEVEL meter reading of -6 dBm.	
7	Turn METER switch on 940A to RECEIVE LEVEL.	
8	Adjust TRANSMIT LEVEL control on 943A for LEVEL meter reading on 940A of transmit level for forward reference line.	
9	Connect 940A and 943A as shown in Figure 10.	

Table 6. Forward Reference Testing With 942A-1 at Transmit Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
10		Connect 942A-1 as shown in Figure 10.
11		Set controls on 942A-1 as follows: LOCATION switch to XMT END IMPEDANCE switch as applicable RCV REF,
12		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale. (At this level, the transmit frequency will be 1700 Hz ± 10 Hz.)
13		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test. NOTE: No further adjustment of controls on the 942A-1 should be necessary.
14	Turn TUNING MODE switch on 943A to MANUAL.	
15	Adjust MANUAL tuning control on 943A for FREQUENCY display on 940A of zero-level reference frequency for circuit under test.	
16	On 940A, adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
17	Adjust MANUAL tuning control on 943A for FREQUENCY display on 940A of zero-delay reference frequency for circuit under test. (IF 1700 Hz IS SATISFACTORY FOR REFERENCE, THEN TURN TUNING MODE SWITCH TO REFERENCE; IF DESIRED, THE 942A TRANSMIT FREQUENCY CAN BE TRIMMED BY ADJUSTING THE 943A TRANSMIT LEVEL CONTROL).	
18	Push DELAY REF SET button on 940A. DELAY meter should read 0 μs.	
19	Turn DELAY RANGE switch on 940A to 90. DELAY meter should read 0 ±2 μs.	

Table 6. Forward Reference Testing With 942A-1 at Transmit Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
20	On 943A, turn TUNING MODE switch to SINGLE SWEEP.	
21	On 943A, adjust SWEEP LIMITS LOW control for FREQUENCY display on 940A of lowest frequency in band of interest. (If adjustment doesn't affect frequency, push START button and then adjust control.)	
22	Push START button on 943A.	
23	Adjust SWEEP LIMITS HIGH control on 943A for FREQUENCY display on 940A of highest frequency in band of interest.	
24	Turn TUNING MODE switch on 943A to SWEEP.	
25	Set SWEEP TIME switch and FINE control on 943A for desired sweep time.	
26	Adjust DELAY RANGE switch on 940A for optimum DELAY meter readings over the swept band.	
27	Record level and delay information as required.	

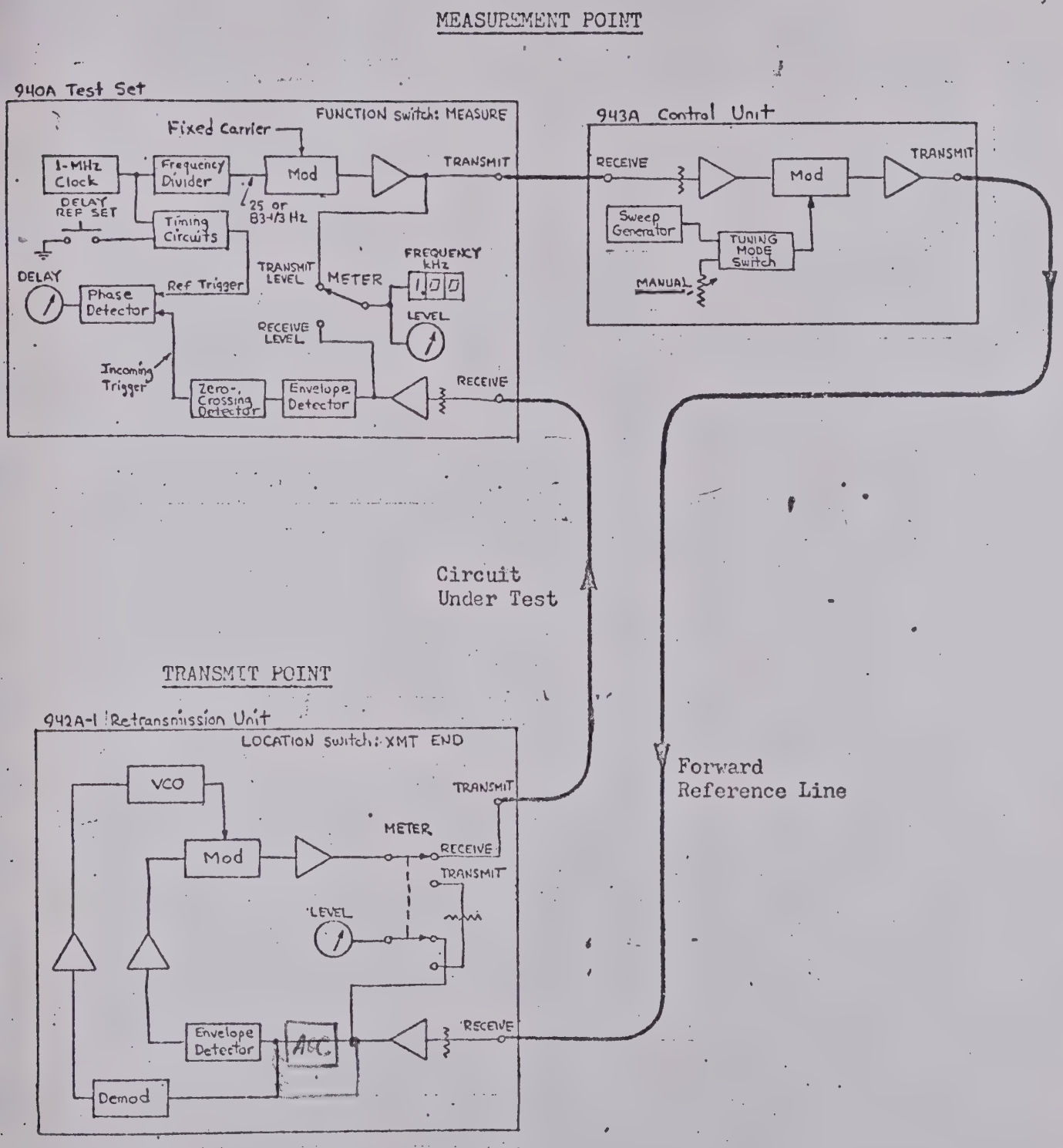


Figure 10. Forward Reference Testing With 942A-1 at Transmit Point

Table 7. Forward Reference Testing With 942A-2 at Transmit Point

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment (Figure 11) as described in paragraph 5.05	
2	Connect test equipment as shown in Figure 11.	
	MEASUREMENT POINT	TRANSMIT POINT
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
4	Adjust MANUAL TUNING control for FREQUENCY display of test tone frequency for forward reference line (typically, 1.80 kHz).	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit level for forward reference line.	
6		Set controls on 942A-2 as follows: LOCATION switch to XMT END IMPEDANCE switch as applicable XMT END switch (rear panel) to MAN
7		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
8		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test.
9	Turn METER switch to RECEIVE LEVEL.	

Table 7. Forward Reference Testing With 942A-2 at Transmit Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
10		Adjust TUNING control on 942A-2 for FREQUENCY display on 940A at measurement point of zero-level reference frequency for circuit under test.
11	Adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
12		Adjust TUNING control on 942A-2 for FREQUENCY display on 940A at measurement point of zero-delay reference frequency for circuit under test.
13	Push DELAY REF SET button. DELAY meter should read 0 μs.	
14	Turn DELAY RANGE switch to 90. DELAY meter should read 0 ±2 μs.	
15		Operate XMT END switch (rear panel) to AUTO.
16		Adjust SWEEP controls on rear panel for required frequency limits and sweep time. See paragraph 5.08.
17	Adjust DELAY RANGE switch for optimum DELAY meter reading over the swept band.	
18	Record level and delay information as required.	

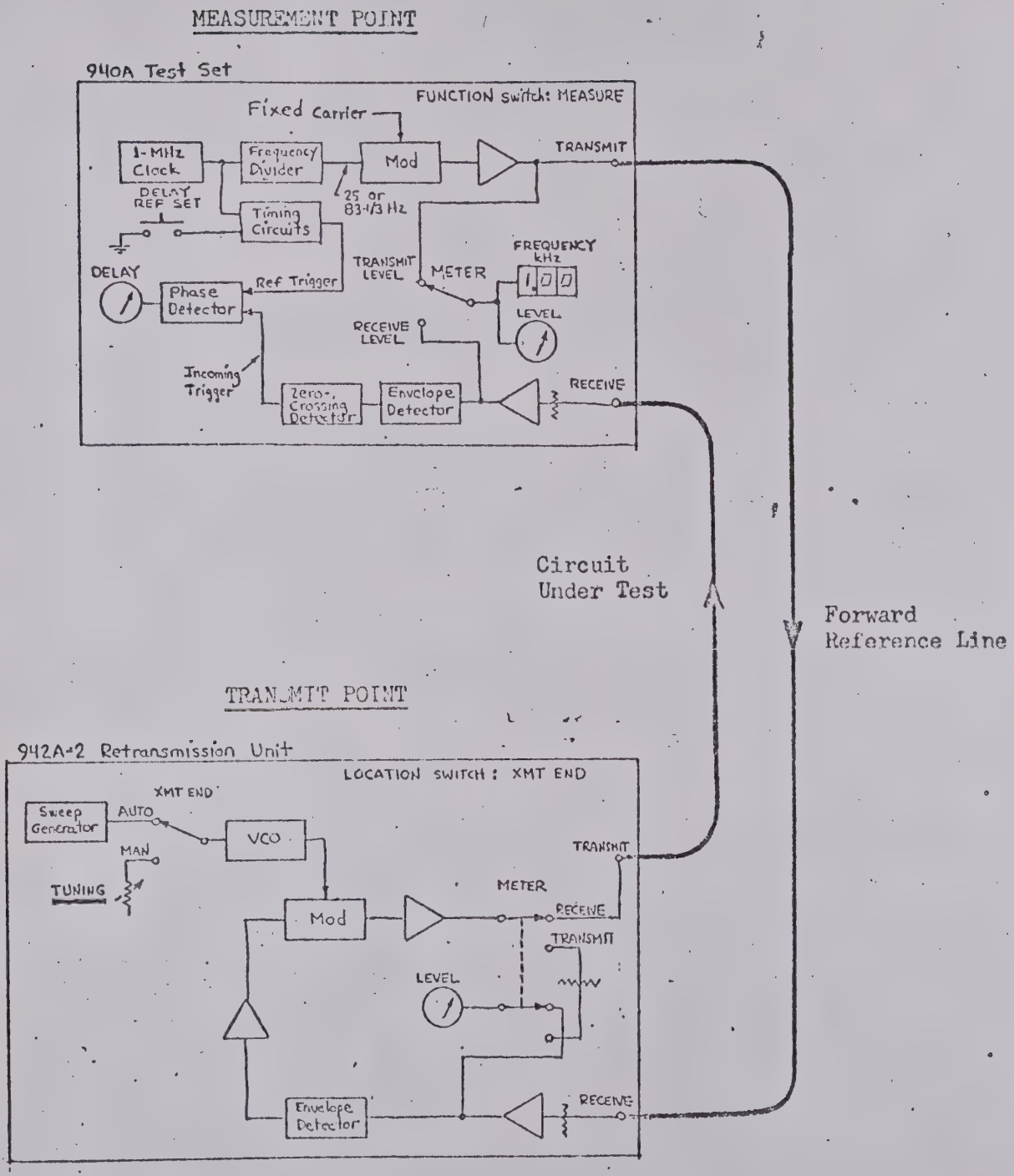


Figure 11. Forward Reference Testing With 942A-2 at Transmit Point

Table 8. Intermediate Point Testing With 942A-1 at Transmit Point

STEP	PROCEDURE	
1	At intermediate point and at each end of circuit under test, turn on test equipment (Figure 12) as described in paragraph 5.05.	
	MEASUREMENT POINT	TRANSMIT POINT
2	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
3	Connect TRANSMIT and RECEIVE on 940A to RECEIVE and TRANSMIT, respectively, on 943A.	
4	Set controls on 943A as follows: IMPEDANCE switch as applicable (same as 940A) TUNING MODE switch to REFERENCE	
5	Adjust MANUAL TUNING control on 940A for FREQUENCY display of 1.70 kHz.	
6	Adjust TRANSMIT LEVEL switch and vernier on 940A for LEVEL meter reading of -6 dBm.	
7	Turn METER switch on 940A to RECEIVE LEVEL.	
8	Adjust TRANSMIT LEVEL control on 943A for LEVEL meter reading on 940A of transmit level for forward reference line.	
9	Connect 940A and 943A as shown in Figure 12.	

Table 8. Intermediate Point Testing With 942A-1 at Transmit Point (cont)

STEP	PROCEDURE
	MEASUREMENT POINT / TRANSMIT POINT
10	Connect 942A-1 as shown in Figure 12.
11	Set controls on 942A-1 as follows: LOCATION switch to XMT END IMPEDANCE switch as applicable
12	Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale. (At this level, the transmit frequency will be 1700 Hz.) ±10Hz.
13	Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test. NOTE: No further adjustment of controls on the 942A-1 should be necessary.
	RECEIVE POINT
14	Connect 942A-1 or -2 as shown in Figure 12.
15	Set controls on 942A as follows: LOCATION switch to RCV END IMPEDANCE switch as applicable
16	Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
17	Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for return reference line.
18	Adjust TUNING control on 942A for frequency display on 940A at measurement point of test tone frequency for return reference line (typically, 1.80 kHz).
19	Set FREQUENCY COUNTER INPUT switch (rear

Table 8. Intermediate Point Testing With 942A-1 at Transmit Point (cont)

TEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
20	Turn TUNING MODE switch on 943A to MANUAL.	
21	Adjust MANUAL tuning control on 943A for FREQUENCY display on 940A of zero-level reference frequency for circuit under test.	
22	On 940A, adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
23	Adjust MANUAL tuning control on 943A for FREQUENCY display on 940A of zero-delay reference frequency.	
24	Push DELAY REF SET button on 940A. DELAY meter should read 0 μs.	
25	Turn DELAY RANGE switch on 940A to 90. DELAY meter should read 0 ±2 μs.	
26	On 943A, turn TUNING MODE switch to SINGLE SWEEP.	
27	On 943A, adjust SWEEP LIMITS LOW control for FREQUENCY display on 940A of lowest frequency in band of interest. (If adjustment doesn't affect frequency, push START button and then adjust control.)	
28	Push START button on 943A.	
29	Adjust SWEEP LIMITS HIGH control for FREQUENCY display on 940A of highest frequency in band of interest.	

Table 8. Intermediate Point Testing With 942A-1 at Transmit Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
30	Turn TUNING MODE switch to SWEEP.	
31	Set SWEEP TIME switch and FINE control for desired sweep time.	
32	Adjust DELAY RANGE switch on 940A for optimum DELAY meter readings over the swept band.	
33	Record level and delay information as required.	

Table 9. Intermediate Point Testing With 942A-2 at Transmit Point

STEP	PROCEDURE	
1	At intermediate point and at each end of circuit under test, turn on test equipment (Figure 13) as described in paragraph 5.05.	
2	Connect test equipment as shown in Figure 13.	
	MEASUREMENT POINT	TRANSMIT POINT
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
4	Adjust MANUAL TUNING control for FREQUENCY display of test tone frequency for forward reference line (typically, 1.80 kHz).	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit level for forward reference line.	
6	Set FREQUENCY COUNTER INPUT switch (rear panel) to EXTERNAL.	
7		Set controls on 942A-2 as follows: LOCATION switch to XMT END XMT END switch (rear panel) to MAN IMPEDANCE switch as applicable.
8		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
9		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test.

Table 9. Intermediate Point Testing With 942A-2 at Transmit Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
10		Adjust TUNING control on 942A-2 for FREQUENCY display on 940A at measurement point of zero-level reference frequency for circuit under test.
		RECEIVE POINT
11		Set controls on 942A-1 or -2 as follows: LOCATION switch to RCV END IMPEDANCE switch as applicable
12		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
13		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for return reference line.
14	Set FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL.	
15	Turn METER switch to RECEIVE LEVEL.	
16		Adjust TUNING control on 942A for FREQUENCY display on 940A at measurement point of test tone frequency for return reference line (typically, 1.80 kHz).
17	Adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
18	Set FREQUENCY COUNTER INPUT switch, (rear panel) to EXTERNAL.	

Table 9. Intermediate Point Testing With 942A-2 at Transmit Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
19		Adjust TUNING control on 942A-2 for FREQUENCY display on 940A at measurement point of zero-delay reference frequency for circuit under test.
20	Push DELAY REF SET button. DELAY meter should read 0 μs.	
21	Turn DELAY RANGE switch to 90. DELAY meter should read 0 ±2 μs.	
22		Operate XMT END switch (rear panel) to AUTO.
23		Adjust SWEEP controls on rear panel for required frequency limits and sweep time. See paragraph 5.08.
24	Adjust DELAY RANGE switch for optimum DELAY meter readings over the swept band.	
25	Record level and delay information as required.	

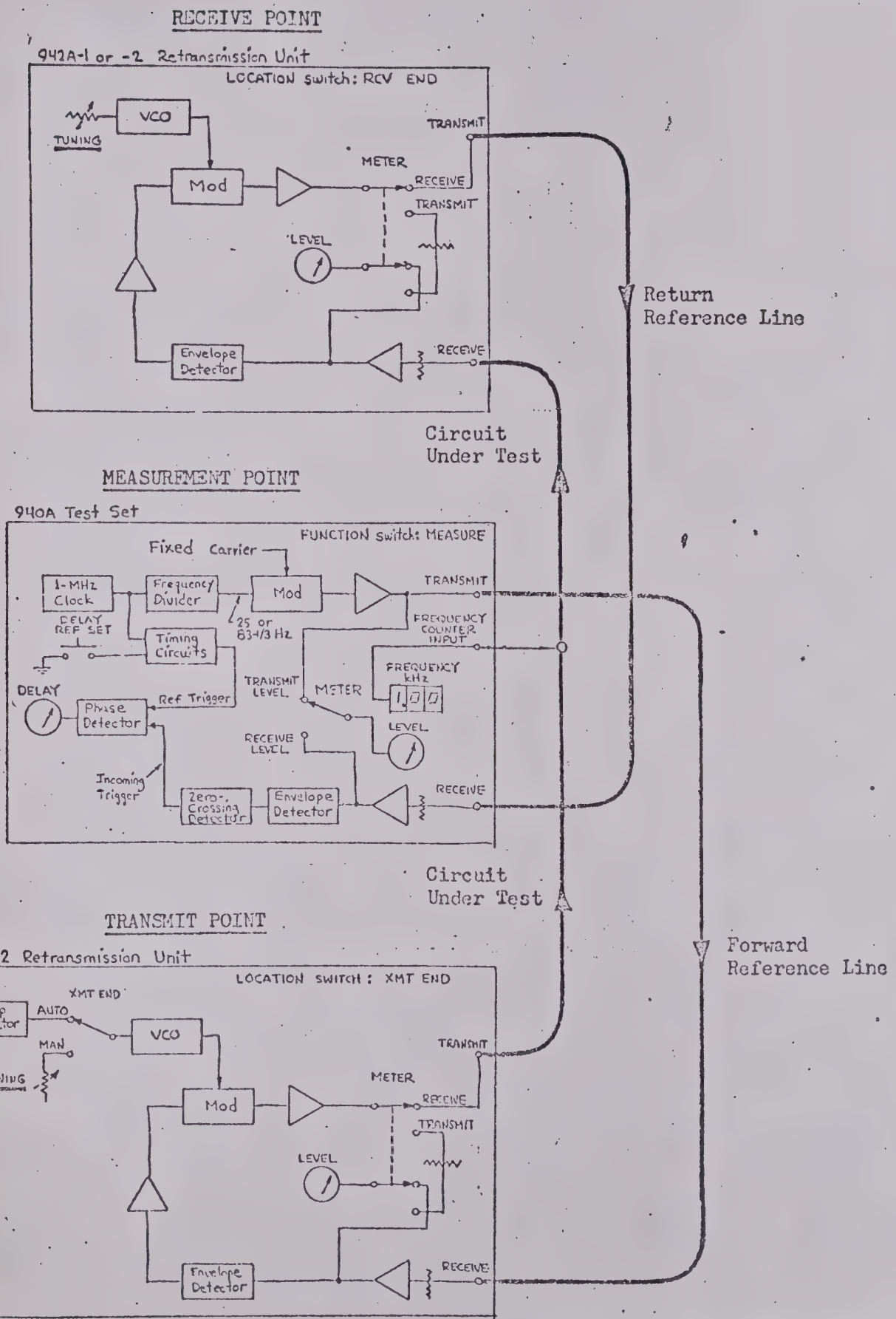


Figure 13. Intermediate Point Testing With 942A-2 at Transmit Point

6. MAINTENANCE

6.01 This section of the manual pertains to maintenance that can be performed at the operator level. If further information covering service or maintenance of the 942A is needed, contact the Customer Service Department, Sierra Electronic Operation, Philco-Ford Corporation, 3885 Bohannon Drive, Menlo Park, California 94025, telephone (415) 322-7222.

NOTE: If defective equipment is to be returned to the factory under terms of the Warranty, be sure to contact the Customer Service Department of Sierra Electronic Operation for specific instructions prior to packing and shipping the 942A.

Replaceable Parts

6.02 Parts that can be replaced easily by the operator are listed in Table 10. Replacement of circuit boards or components on the circuit boards will probably necessitate testing or calibration that is beyond the scope of this manual; refer to operation/maintenance manual SMM-942A.

Table 10. Field Replaceable Parts

DESCRIPTION	SIERRA STOCK NO.	MFR	MFR PART NO.
Fuse, ~~slow-blow~~, 0.5A, 250V	9/3200036	LITTELFUSE	312.500 3AG
Power cord	916400019	Belden	17258

TO BE VERIFIED

Operational Test

6.03 In the procedure that follows, the performance of the 942A is checked out using a 940A test set as a vf signal source, level meter, and frequency counter. Testing covers: accuracy of level measurement, transmit signal range (level and frequency), remote control of 942A-1 transmit signal frequency, and automatic tuning of 942A-2 transmit signal.

PRELIMINARY

Step 1
Turn on 940A and 942A as described in paragraph 5.05.

Step 2
Set controls on 940A as follows:

FUNCTION switch to MEASURE
MODULATION switch to OFF
IMPEDANCE switch to 600

TUNING MODE switch to 100 Hz LOCK or MANUAL
DELAY RANGE switch to OFF
METER switch to TRANSMIT LEVEL

FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL
TRANSMIT LEVEL switch to 0 dBm
RECEIVE LEVEL switch to 0 dBm

RECEIVE LEVEL vernier to CAL

Step 3
Set controls on 942A as follows:

IMPEDANCE switch to 600Ω
LOCATION switch to RCV END
RECEIVE LEVEL switch to 0 dBm

RECEIVE LEVEL vernier to CAL

Step 4
Connect TRANSMIT and RECEIVE on 940A to RECEIVE and TRANSMIT, respectively, on 942A.

Step 5
Adjust MANUAL TUNING control on 940A for FREQUENCY display of 1.70 kHz.

Step 6
On 940A, adjust TRANSMIT LEVEL vernier for LEVEL meter reading of -6.0 dBm. On 942A, LEVEL meter should read -6.0 dBm ±0.1 dB.

Step 7
Turn METER switch on 940A to RECEIVE LEVEL.

Step 8
Adjust TRANSMIT LEVEL control on 942A through its range and read levels on 940A. Requirement: greater than +3.8 dBm (cw) to less than -20.0 dBm (ccw).

Step 9
Adjust TRANSMIT LEVEL control on 942A for 0.0 dBm on LEVEL meter of 940A.

Step 10
On 942A, push in METER switch. LEVEL meter on 942A should read 0.0 dBm ±0.1 dB.

Step 11
Adjust TUNING control on 942A and check range on FREQUENCY display of 940A. Requirement: less than 0.20 kHz to greater than 4.00 kHz.

Step 12
On 942A, set LOCATION switch to XMT END.

Step 13
This step is not applicable to 942A-2. On 940A, adjust TRANSMIT LEVEL controls for readings on 942A-1 LEVEL meter of -1, -6, and -11 dBm. At each level, read FREQUENCY display on 940A. Requirement: greater than 4.00 kHz at -1 dBm; 1.70 kHz ±0.10 kHz at -6 dBm; and less than 0.20 kHz at -11 dBm.

NOTE: The remaining steps in this procedure are not applicable to 942A-1.

Step 14
Set controls on rear panel of 942A-2 as follows:

XMT END switch to AUTO
SWEEP HIGH LIMIT control full cw
SWEEP LOW LIMIT control full ccw
SWEEP TIME control full cw

Step 15
Read sweep range on FREQUENCY display of 940A. Requirement: less than 0.20 kHz to greater than 4.00 kHz.

Step 16
Check total sweep time (up and down) by timing interval between two successive readings of highest transmit frequency. Requirement: 60 seconds or more

Step 17
Turn SWEEP TIME control full ccw and repeat step 16. Requirement: 2 seconds or less.

Step 18
Set XMT END switch to MAN.

Step 19
Adjust TUNING control on 942A-2 and check range on FREQUENCY display of 940A. Requirement: less than 0.20 kHz to greater than 4.00 kHz.

PRELIMINARY

7. REFERENCES

7.01 Additional publications on the 942A are available from Sierra Electronic Operation:

(a) 942A Retransmission Unit, Operation/Maintenance Manual SMM-942A

PRELIMINARY
ALL MATERIAL SUBJECT TO CHANGE WITHOUT NOTICE

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